Guide for ultrasonic leak detection in compressed air systems in an industrial environment

Copyright © 2007 by SDT International n.v. s.a.
First edition, English version.
All rights reserved. Reproduction in any form of all or part of this document is not permitted without the written permission of SDT International n.v. s.a.
SDT International n.v. s.a.
Bd. de l'Humanité 415,
B – 1190 Brussels (BELGIUM)
Tel: ++32.2.332.32.25
Fax: ++32.2.376.27.07
e-mail: info@sdt.be
web page: http://www.sdt.be

Contents

1. Detecting compressed air leaks: a double-edged issue. 5

2. Pay for the air you use, not for leaks! 7

3. Detecting leaks by listening to the ultrasounds that they produce. 9

4. Implementing a campaign to search for leaks and drawing the most benefit from it. 11

4.1 Devising an effective strategy 11
4.2 Devising the procedure 12
4.3 Choosing appropriate detection equipment 14
4.4 Using the SDT 170 detector properly 16
4.5 Leaks....but where? 19

5. Detecting a leak. 21

6. Recording the data. 23

7. Quantifying a compressed air loss. 25

8. Some practical advice. 37

As the indisputable leader in its field, SDT International designs and produces a large range of measuring instruments for the ultrasonic detection and evaluation of various other physical parameters.
The company's expertise covers a vast array of applications: large and small capacity tightness tests and for underground tanks, the detection of leaks in any pressure system, production quality control and the detection of wear and faults in the predictive maintenance of mechanical equipment.
Our company's success is based on our philosophy and our willingness always to respond to our customers' problems with the most effective, money-saving solutions.

1. Detecting compressed air leaks: a double-edged issue.

Detecting leaks in compressed air systems is a double-edged issue: an environmental one for each one of us and an economic one for every business. Is it because it's an environmental issue that so few business managers feel worried about the topic? Then let's deal with this issue based on the substantial savings that can be made by eliminating this tremendous waste.

A proactive, ultrasonic leak detection campaign quantifying the amount of compressed air lost can be used to easily calculate the amount of benefit generated. The figures then speak for themselves and will convince you to implement a better energy efficiency management programme.

When people talk about energy saving prospects the idea of protecting the environment is, however, never very far removed. Detecting leaks in your compressed air systems addresses these two concerns.

An environmental and an economic issue.

Energy is, and will increasingly become, an important, priority issue because of its price, because supplies are running out and because of the constant fight against climate change etc. In such conditions, why not eliminate completely worthless consumption caused by leaks from compressed air systems? Isn't it time to limit the damage? Especially in view of the fact that the pledges made under the Kyoto Protocol, ratified in February 2005, require us to reduce toxic emissions into the atmosphere by better energy efficiency management.

By 2012, 35 industrialised countries have made a commitment to reduce greenhouse gas emissions by 5% compared with their 1990 levels. They represent 35% of global emissions. As such this target is far from being enough. In addition to this no commitment has been made for after 2012. If you listen to Stephane Dion, the retiring President of the United Nations' conference on climate changes, "We would need ten Kyoto agreements to be able to reduce the effects of climate change. Scientists are saying that there must be a 60% reduction in greenhouse gas emissions within the next fifty years to

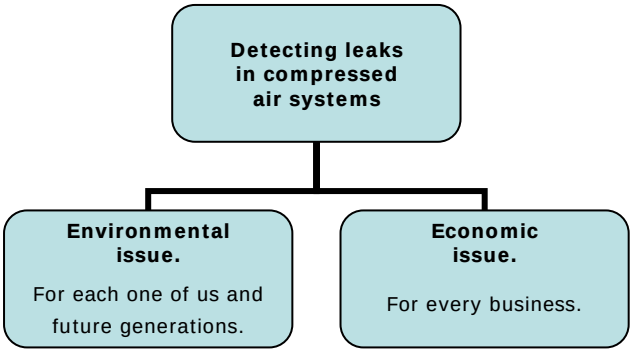
stabilise global warming. Well, if nothing's done, these emissions themselves will increase by 60 %". How much will industry contribute to this?

While you're watching your energy bills rise, not a day goes by without new commitments to reduce CO_2 emissions' quotas being tackled. A double challenge to be taken up by any manufacturer. All the more so because at the beginning of 2007 the European Union undertook to reduce these types of emissions by 20% at least between now and 2020.

Compressed air leaks are very costly in terms of excess consumption of energy.

Some awareness, skills within everyone's reach and, above all, good reactions are all that is needed to incorporate energy concerns into one's production tool management. Contrary to what you might think, managing energy better and/ or investing in energy efficiency can be very profitable. And, this doesn't happen very often, a solution that involves eliminating leaks has immediate benefits both for the environment and for your finances. More generally, admittedly, measures aimed at protecting the environment will incur some costs. In this case, on the other hand, this is balanced out by the benefits. And what is more motivating than combining this with the future of generations to come!

The detection of leaks in compressed air systems, a measure that is within the grasp of any company, is an important step in its commitment to an active energy management policy.


Detecting leaks in compressed air systems
Environmental issue.
For each one of us and future generations.
Economic issue.
For every business.

2. Pay for the air you use, not for leaks!

Compressed air is the most used energy fluid in industry but also the most expensive. Based on 5 years' consumption at a rate of 6,000 production hours a year, it is generally accepted that compressed air production costs are divided into

75 % for the provision of energy,
13 % investment

and 12 % maintenance costs.

Compressed air is expensive for an overall thermodynamic yield (use efficiency) of hardly 10%, even in the best of circumstances.

Compressed air production takes 2nd or 3rd place in a company's energy costs. It is therefore natural to take its improvement potential into consideration It is important and is based essentially on the ideal balance between actual production requirements and pressure levels, on reducing energy losses, on maintaining components, on checking air quality and eliminating leaks in the network.

In some companies, rather than thinking about these improvements, they bring in a compressor to compensate for these losses. This is not an unusual situation...

Leaks may represent

30 - 40 % of the amount consumed.

You must realise that leaks may occur anywhere in the network; online connections, bleed valves, filters, pressure regulators, slide gates, quick release connections, rubber pipes etc. And there are still lots more places in spots that are the most hidden as well as in the most inaccessible places. A real proactive programme to seek out this type of waste is more than vital to reduce the loss to a reasonable amount:

Reducing compressed air losses

to 5 % of the amount consumed.

It's all the more true that if losses prevent minimum service pressure being reached, you very often tend to increase pressure. Which increases the percentage of losses. Taking into account the number of components in any compressed air system, it is easy to imagine the potential for leaks and the financial benefits of a detection campaign. This can be calculated very quickly using the cost of the smallest leaks and by simple multiplication:

A single 1 mm leak at 6 bars

is already costing you €144 per year.

At 12 bars,

it will cost you €480 per year.

Annual costs of energy caused by an undetected leak*.

Hole Ø [mm]	Loss of air at 6 bars [l/s]	Loss of air at 12 bars [l/s]	Loss of energy in kWh at 6 bars	Loss of energy in kWh at 12 bars	Costs at 6 bars [EUR]	Costs at 12 bars [EUR]
1	1.2	1.8	0.3	1	144	480
1.5	2.6	3.7	0.7	2.0	312	987
2	4.8	7.4	1.2	4.1	576	1.973
2,5	7.5	12.8	1.9	7.5	900	3.413
3	11.1	20.8	3.1	12.7	1,488	6,096
Costs to be multiplied by the number of leaks						

**kWh x 0.06 EUR x 8,000 operating hours per year.*

3. Detecting leaks by listening to the ultrasounds that they produce.

Leaks emit ultrasounds.

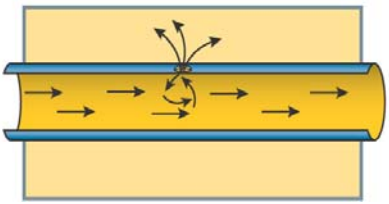
It is therefore vital to understand what ultrasounds are and how they relate to leaks in order to understand how to detect them properly.

Sounds and ultrasounds are mechanical vibrations of matter. Ultrasound is the same type of vibration as sound but at a frequency higher than 20 kHz, which is inaudible to the human ear, which has a range of between 15Hz and 20Hz.

Compared with the diffuse emission of sounds, ultrasounds spread in a concentrated fashion in one direction. They can be compared with a beam of light whose intensity decreases depending on the distance.

Ultrasounds are generated naturally by fluid turbulence phenomena caused by pneumatic or hydraulic problems (leaks) or by friction phenomena caused by mechanical problems. Electrical problems, such as arcs, corona effects, etc. also generate ultrasounds.

In the event of a leak from a compressed air system, the air friction that escapes generates ultrasounds on the sides of the perforation. And it does this whatever the size of the leak, its flow rate and the dimension of the hole, however small it is.



Ultrasounds can also be produced artificially using a transmitter to perform tightness tests, for example.

As the acuity of the human ear is limited, it is vital to use a detection instrument to listen to ultrasounds, to detect where they are coming from and consequently to locate the leak accurately.

The SDT 170 ultrasound detector operating principle.

The SDT 170 detects ultrasound signals, converts them into audible frequencies and amplifies them. The aim is to transpose the signal received into an interpretable audible signal using heterodyne technology. This solution extends human hearing capacity beyond the audible range into the ultrasound band.

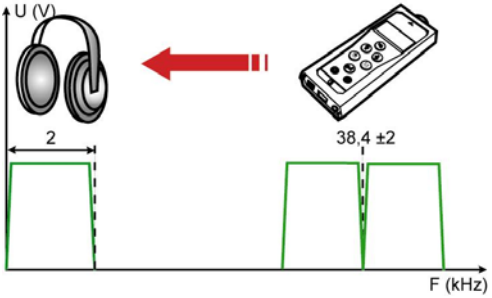


Figure 1 - The main function of the SDT 170 is to convert high frequency signals into audible signals.

It must be noted that the detector's central frequency band can be adjusted to a specific frequency between 15.1 and 190.7 kHz ; the default frequency is 38.4 kHz.

Figure 2 - The frequency bands are used depending on the type of sound to be detected.

For the purposes of detection, the SDT 170 detector is only sensitive to ultrasound vibrations. It restores the turbulence effects, i.e. the actual sound of the leak and it quantifies this leak in dBµV.

4. Implementing a campaign to search for leaks and drawing the most benefit from it.

A proactive campaign for looking for leaks requires devising a schedule for performing services repeatedly over time.
This is completely different from the prompt, unforeseen reactions required by leaks that appear suddenly. This proactive campaign involves using the most appropriate tool and attachments for each location, observing an appropriate methodology, managing the data relating to each leak, documented, validated repair measures and, finally, as far as possible, quantifying leaks and doing the calculation resulting from the campaign.

4.1 Devising an effective strategy

The proper management and success of a maintenance programme for your compressed air network is based essentially on the quality of your strategic plan.

- **DEFINE THE OBJECTIVES** - Defining what the objectives are apart from the main one which is to drastically reduce energy costs by only agreeing to a small investment in a detector is vital.

Any effective maintenance strategy is necessarily based on a well defined goal. Thus the first question to ask yourself is, quite logically, "What objectives must be achieved by applying a maintenance plan to my compressed air network?"

Here are some examples:

- Drastically reduce your energy costs with just a small investment.
- Detect, quantify the amount and repair any compressed air leak in the existing system.
- Restrict the overall amount of losses to 5% of the amount consumed.
- Take the strain off your compressors and prolong their lifespan.

- Make all the staff in your company aware of the high cost price of compressed air.
- Train the users involved in the most effective methods for maintaining the compressed air network.
- Etc.

- **MAKE ALL STAFF AWARE** - To achieve maximum efficiency it is important to make all staff aware of this by posting permanent notices about the objectives. These objectives must be spread around the whole company so that each member of staff comes up against them all the time.

- **RECONSIDER THE WHOLE OF YOUR NETWORK** - Managing a maintenance programme for your network is much more than looking for leaks and making repairs. It's also thinking about the network as a whole and making the improvements that are vital for greater efficiency.

4.2 Devising the procedure

Your procedure must be devised so that it achieves three results: the safety, reliability and effectiveness of your programme for looking for leaks. For optimum management of your compressed air network, some procedural steps deserve special attention:

- **SAFETY** – This means compiling a procedural manual. Particular attention must be paid to this document. It will specify the frequency of inspections for each control point as well as the most appropriate sensor and attachments for each of these points.
The checking procedure will be detailed in five phases: detecting, locating, quantifying, repairing and checking the repair. It will also describe how each person involved must record that he has observed the procedure for each phase and also record information about the leak.

- **FREQUENCY** – An effective annual maintenance plan requires 3 - 4 inspections of all the points of the network. Moving parts or those in a hazardous environment will be checked every month. You will then ensure that you have detected all new leaks as early as possible after they appeared and that you have checked the repairs required by previous inspections.

- **KNOWING ALL ABOUT THE NETWORK** – for yourself and the people involved, knowledge of the network, compressors, the various pressure levels necessary are vital to devising the maintenance plan and observing it.

- **UPDATING THE CONTROL PLANS** – Keeping the installation diagrams up to date will enable you to devise the most appropriate plan of all the points to be checked. All leaks will be recorded there progressively, with their precise location, their frequency, how big they are, the type of repair carried out and the check on this.

- **CHOICE OF EQUIPMENT** – It is important to determine precisely the most appropriate sensors and attachments that must be used for each detection point.

- **TRAINING** – All users of the ultrasound leak detector will have received practical and theoretical training from an experienced person before starting his job.

- **OBSERVING THE 4 STAGES OF THE PROCEDURE** – The four stages of the programme for looking for leaks must be observed; identify, locate, repair, check again.

- **CHECKING REPAIRS** – To be incorporated into the procedure: an ultrasound check of each leak repaired. On the one hand, the person who checks is not always the one who repairs, and, on the other hand, you have to check that another leak hasn't been created accidentally when working on the network.

- **DATA MANAGEMENT** – Quantifying how much is leaking is a difficult matter. From feedback from major users and its specialist expertise, SDT provides you with a unique approach to quantification. Recording such figures with the history of each leak will allow you to compile an annual table of savings generated by your network maintenance. They will also encourage the transfer of skills within your business.

4.3 Choosing appropriate detection equipment

As specified in the procedure, each check point requires the use of a sensor or the most appropriate fitting. Let us always bear in mind that the ultrasound frequency is low energy and that is spreads in a concentrated way and in a single direction.

The most effective ultrasound sensor corresponds to each control and locating situation:

- The internal detector sensor
- The flexible sensor
- The EDS (Extended Distance Sensor) adapter
- The parabolic sensor.

For easy to get to places

All SDT 170 ultrasound detectors are fitted with an open internal sensor to detect compressed air, gas and vacuum leaks. It's the ideal sensor for daily searches and for a quick check of easily accessible places opposite the operator. Several precision attachments (fig.3 nos. 2 - 5) may help to locate exactly where the leak is.

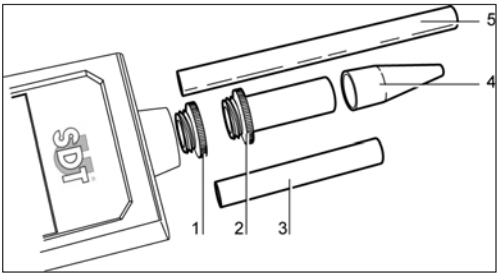
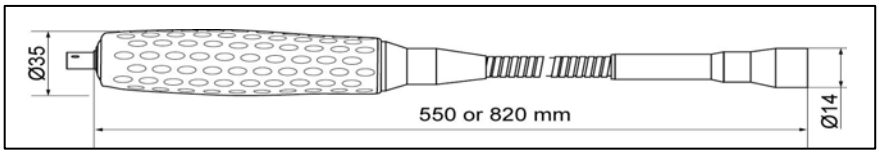


Figure 3 – The SDT 170's internal sensor and the precision attachments.

For difficult to get to places

This flexible rod with integral sensor has been designed to detect leaks in places deemed to be inaccessible and to get round the parts to be checked. In fact, it can be bent, turned and pointed in any direction. Two lengths available: 550 and 820 mm.

Figure 4 – The flexible sensor.



Average distance (up to 10 m).

Generally, a large part of the compressed air system is located at ceiling level. You need to use a ladder or lifter to inspect it. There is an easier way… The EDS (Extended Distance Sensor) allows you to inspect it while keeping your feet on the ground. This conical shaped adapter is fitted with a threaded tip. It is screwed onto the SDT 170's internal sensor and concentrates the ultrasonic frequencies. It enables better detection at a medium distance and it improves the accuracy of the approach.

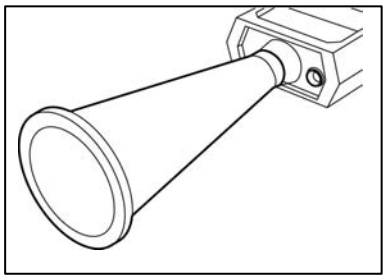


Figure 5 - The EDS (Extended Distance Sensor) adapter.

Long distance (up to 25 - 30 m).

If the place to be inspected or the leak to be located is out of range of the detector in spite of using the EDS (fig. 5), you can use this parabolic sensor. This is a high precision signal concentrator which enables detection at very long distances. This transparent plexiglas parabola is fitted with a particularly sensitive sensor. It has two sights for extremely accurate location: one is a "rifle" sight and the other a powerful laser sight.

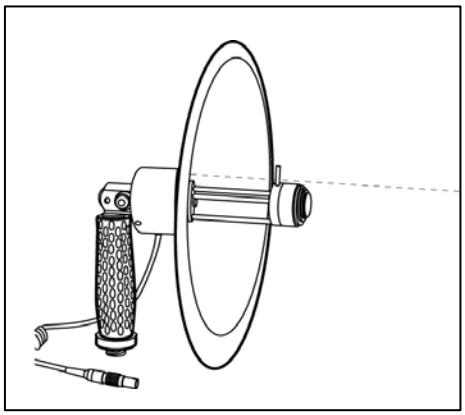


Figure 6 – The parabolic sensor and its laser sight.

4.4 Using the SDT 170* detector properly

1. If you don't use the SDT 170 detector's internal sensor, connect the selected sensor to the connection for the external sensor. Then connect the headphones to the unit's audio output. You must use these to search for the leak, to locate it and to be able to quantify it. You will also be protected from surrounding parasitic noises.

2. Start the apparatus (fig. 8 page 18).

3. Ensure that the sensor connected is automatically recognised by the SDT 170 unit. The sensor ID is displayed in the top left corner of the screen (fig. 7, Type of sensor).

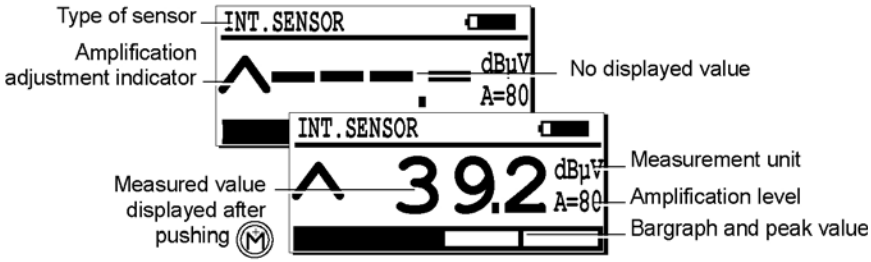


Figure 7 – The LCD display

4. Check the battery level on the icon in the upper right corner of the screen (fig. 7).

5. After the company safety procedures have been performed, you start detecting leaks as described in Chapter 5.

*All details in the user manual supplied with the unit.

The importance of the digital display.

Your SDT detector may be fitted with a screen with a bar graph display or a digital display for measuring the leak. More precisely, the digital display is vital for quantifying leaks in view of an economic approach following your strategy for finding leaks.

Apart from the fact that measures can be traced and it is very user-friendly, there are many advantages from saving data and transferring it to a PC. Some versions have this option.

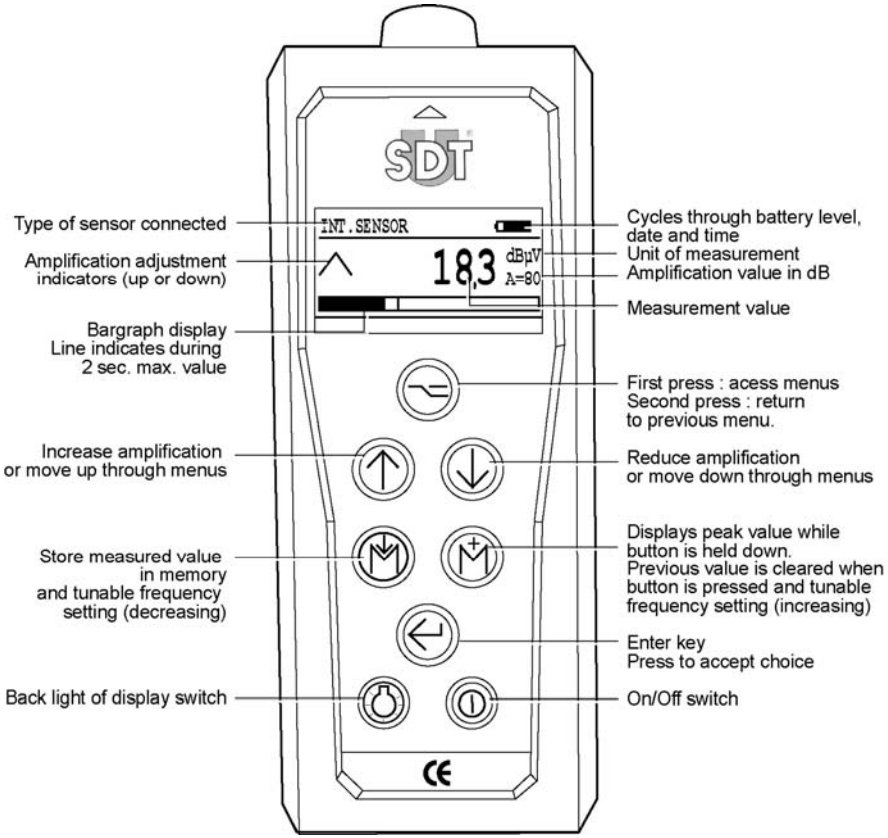

Type of sensor connected
Amplification adjustment indicators (up or down)
Bargraph display Line indicates during 2 sec. max. value
Increase amplification or move up through menus
Store measured value in memory and tunable frequency setting (decreasing)
Back light of display switch
INT.SENSOR
18,3
dBµV
A=80
Cycles through battery level, date and time
Unit of measurement
Amplification value in dB
Measurement value
First press : acess menus Second press : return to previous menu.
Reduce amplification or move down through menus
Displays peak value while button is held down. Previous value is cleared when button is pressed and tunable frequency setting (increasing)
Enter key Press to accept choice
On/Off switch

Figure 8 – The basic functions of the SDT 170

4.5 Leaks....but where?

Leaks may occur anywhere in your compressed air system! A look at the top twelve most common leaks:

1. Connections on the supply line.
2. Quick coupler
3. Filters
4. Pneumatic cylinders.
5. Regulator/dryer assembly
6. Pressure regulators
7. Rubber pipes
8. Regulator/lubricator assembly
9. Isolation valves
10. Control valves
11. Automatic drain traps
12. Various pipes

As a rough guide, the table below gives you the distribution of compressed air used in industry where there is absolutely no proactive predictive network maintenance programme.

Distribution of the amounts of compressed air used in industry (international averages)	
Consumption by equipment	43 %
Leaks into the atmosphere	34 %
Inappropriate uses	16 %
Purged air	5 %
Failed drain traps	2 %

These figures are averages drawn up by Plant Support & Evaluations Inc. – Audit Division

5. Detecting a leak.

The detection service as such requires the application of some basic principles aimed mainly at efficiency and ease of work.

- For repeating and comparing measures you will always use the same sensor and/or attachment for the same place to be tested.
- The unit's level of amplification will be selected depending on the working environment.
- The exact location will be determined by sweeping in all directions searching for the strongest ultrasound signal. This is when the highest value appears on the screen. It's simple and intuitive given that it's actually the noise of the leak that you are hearing.
- If it is not to be repaired immediately you will have to provide an exact location of the place.
- Each repair must be checked as must the immediate surroundings.

Procedure:

1. Start searching with maximum amplification, sweeping from the top to the bottom and from left to right with the unit or the sensor that you have connected to the unit, in order to locate the leak accurately.

   Detecting the hissing sound that is typical of ultrasounds indicates that there is a compressed air or vacuum leak. If the signal detected is too powerful, reduce the amplification level to make it more comfortable to work.

2. As soon as you detect the hissing sound, move the sensor closer to the source to locate the leak. Press the down arrow to reduce the signal level given that it will increase as you approach the precise location of the leak.

3. This will be at the place where the signal is most powerful and when the highest value is displayed on the screen.
4. Select the amplification level depending on your working environment so that you do not have either of the two indicator arrows on the screen of the SDT 170. They may, still be there when the amplification level is at its maximum (A=80) or at its minimum (A=10).
5. Note down or save the leak measurement (dBµV) displayed on the screen.
6. Report this precise spot if the leak is to be repaired immediately or mark it with a locating mark if it is to be repaired later.
7. Note down as much information as possible about the leak: the place, the type of leak, how big it is, the identity of the inspector and the repairer are very useful items to note down.

Compressed air is expensive. Compressed air losses = waste!
1. Controlling this energy vector is an absolute necessity. Compressed air is expensive.
2. Compressed air costs €0.6 - 3.0 per Nm^3 depending on the optimisation of the plant.
3. The overall thermodynamic efficiency (efficiency of use) of a plant is very low: only ± 10 % on average taking into account energy leakage, motor, transmission and compressor losses, load losses and leaks.
The potential for improvement is therefore very great.

6. Recording the data.

Recording data relating to each leak inspected is a vital step in your campaign to search out leaks. It must be incorporated into your maintenance plan with the option to add records appropriate for your strategy which will meet the objectives of each campaign.

Example of an internal data record sheet for an inspected leak.

COMPANY LOGO

Detecting compressed air leaks:

DEPARTMENT: .....
MACHINE (or premises): .....
INSPECTOR: ……
SENSOR: ……
MEASURING DISTANCE: ……

Date and inspector	Department	Leak number	Description and location	Size of the leak in dBµV	Loss of air in L/h	Air loss €/y	Person responsible and date of repair	Person responsible and date of second check

Data recorded for the inspected leak:

Date and inspector
Date and name of the person responsible for checking leaks.

Department
Part of the plant in which the inspection took place (e.g. production workshop, packaging unit etc.).

Leak number
Number on the leak locating mark.

Description / location
Description and location of the leak (e.g. *on the left side of the T at the outlet of boiler no. XXX or at the inlet to pump no. YYYY, see diagram Z*).

Size of the leak in dBµV
The value measured and displayed on the detector screen.

Air loss in L / hour
See tables from page 28 "Quantifying a compressed air loss".

Air loss in € / year
If you have the cost prices of compressed air in your company you can easily estimate the annual financial loss resulting from this leak.

Person responsible and date of repair
Actual date the repair was finished and the name of the person who carried it out.

Person responsible and date of re-check
Date the repaired leak underwent a second ultrasound check and the name of the inspector.

7. Quantifying a compressed air loss.

Quantifying a leak by converting the dBµV into L/y or into SCCM/SCFM is to be planned with the greatest care. It should only be undertaken by competent people who have been trained appropriately.

Given that a very large number of factors may influence the taking of measurements in dBµV, it goes without saying that the user of this type of measuring equipment will first of all include all of these factors so that he can take account of them when he makes his conclusions on quantifying a detected leak.

When detecting leaks in an industrial environment, certain factors may influence the measurements:
The leak orifice size, its shape, its configuration.
The surrounding parasitic ultrasound signals.
The distance between the leak and the sensor.
The position and the working angle of the sensor in relation to the leak axis.
The features of the ultrasound sensor and the conditions under which it is used.
The temperature and humidity level of the air escaping from the leak.
… and very many more.

Quantifying compressed air losses also means evaluating the savings made.

The big question that's asked most often is "Looking for leaks is all very well. But what good is it going to do me? Is it really worth the effort?"

Under certain conditions the method enables each leak detected to be quantified and the gains to be had from its repair to be calculated. There is nothing more gratifying that to be able to compile a quarterly or annual table of savings made by your network maintenance services, in the certainty that energy efficiency is being managed better and there will be a rapid return on investment.

In the tables below you will find the values in dBµV measured for a determined compressed air leak whatever the pressure up to 10 bars inclusive.

- The dBµV measurements in the first two tables are the results of detecting with the internal sensor or the flexible sensor using an SDT 170 S+, M, M+ or MD unit, given that the 170 S model does not have a digital display of the measured value.
- The dBµV measurements in the third and fourth tables are the results of detecting with the parabolic sensor, using one of the units mentioned in the previous paragraph.
- All SDT detectors have been used in the default 38.4 kHz central frequency band.
- The dBµV values were recorded at the loudest level of the leak. They are, therefore, maximum values. You will note that when using the SDT detector in an industrial environment, this noisiest level is rarely detected perpendicular to the leak, but most often at an angle of about 30° to the axis of the leak.

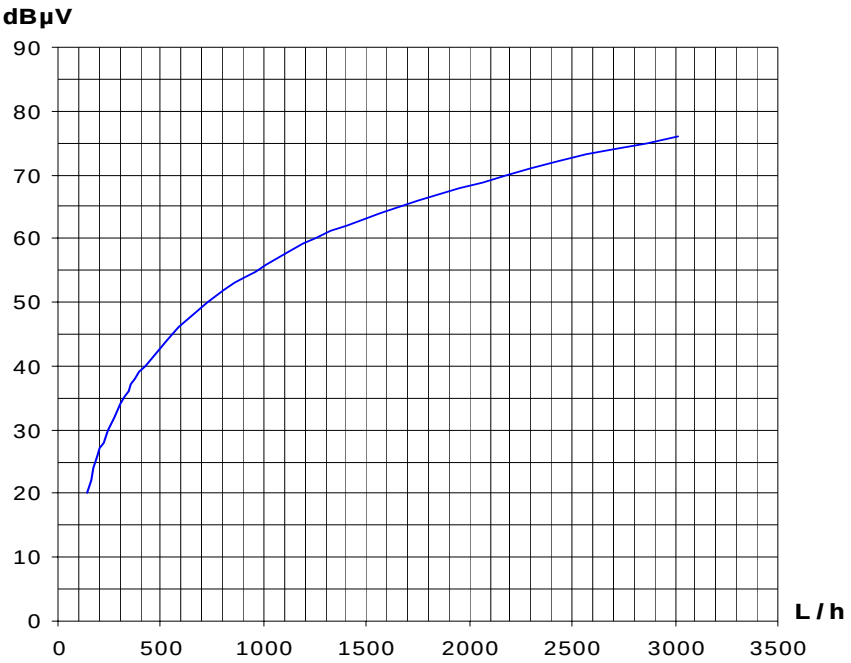
An increase in pressure automatically causes an increase in flow. And, at the same time, the ultrasound signals measured in dBµV by the SDT 170 detector also increase.
You can, therefore, favourably deduce from this that quantifying leaks based on the SDT 170 measurements is independent of the level of pressure used (not always known).

Details of the leak used:
Leak orifice: from 0.2 - 1 mm
Area: from 0.033 - 0.822 mm^2
Important note:
The values in these tables are given as a rough guide and may only be used as guidelines to make the task easier.

Quantifying a compressed air loss.

Measurements with the internal SDT 170 sensor or the flexible sensor.

1 - 6 bars inclusive
0.4 m

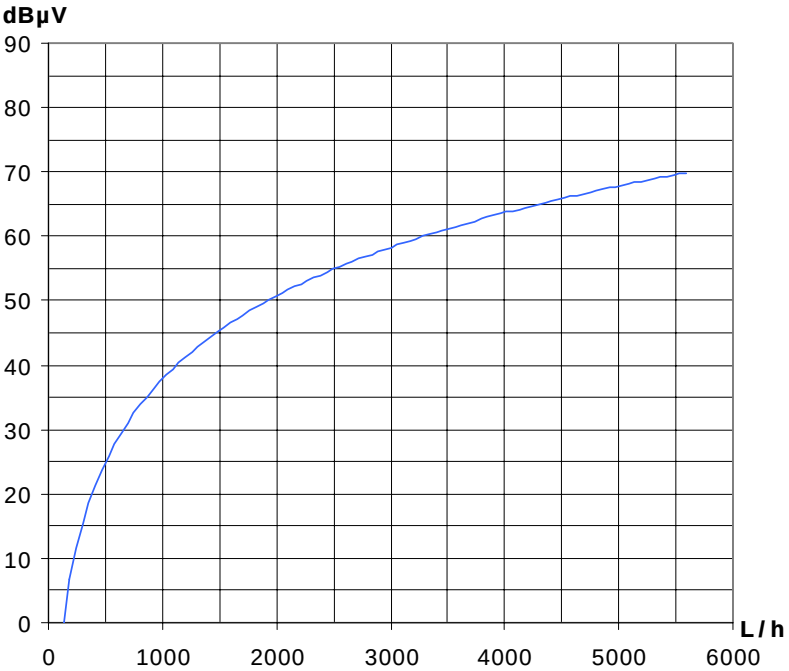


dBµV	L/h	SCCM	SCFM
20	141	2355	0.083
22	158	2627	0.093
24	176	2931	0.104
26	196	3270	0.115
28	219	3647	0.129
30	244	4069	0.144
32	272	4539	0.160
34	304	5063	0.179
36	339	5648	0.199
38	378	6301	0.223
40	422	7029	0.248
42	470	7841	0.277
44	525	8747	0.309
46	585	9758	0.345
48	653	10885	0.384
50	729	12143	0.429
52	813	13546	0.478
54	907	15111	0.534
56	1011	16858	0.595
58	1128	18805	0.664
60	1259	20978	0.741
62	1404	23402	0.826
64	1566	26106	0.922
66	1747	29123	1.028
68	1949	32488	1.147
70	2174	36241	1.280
72	2426	40429	1.428
74	2706	45100	1.593
76	3019	50311	1.777

Quantifying a compressed air loss.

Measurements with the internal SDT 170 sensor or the flexible sensor.

1 - 10 bars inclusive
2 m

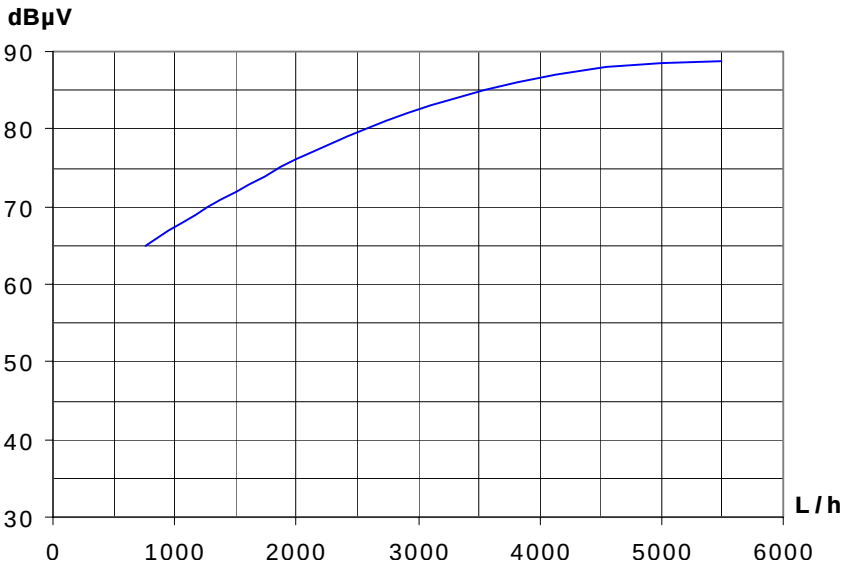


dBµV	L / h	SCCM	SCFM
10	225	3745	0.132
12	250	4169	0.147
14	278	4641	0.164
16	310	5167	0.182
18	345	5753	0.203
20	384	6404	0.226
22	428	7130	0.252
24	476	7938	0.280
26	530	8837	0.312
28	590	9838	0.347
30	657	10953	0.387
32	732	12194	0.431
34	815	13575	0.479
36	907	15113	0.534
38	1010	16826	0.594
40	1124	18732	0.662
42	1251	20854	0.736
44	1393	23217	0.820
46	1551	25847	0.913
48	1727	28776	1.016
50	1922	32036	1.131
52	2140	35665	1.260
54	2382	39706	1.402
56	2652	44205	1.561
58	2953	49213	1.738
60	3287	54789	1.935
62	3660	60996	2.154
64	4074	67907	2.398
66	4536	75600	2.670
68	5050	84165	2.972
70	5622	93701	3.309

Quantifying a compressed air loss.

Measurements with the SDT 170 and the parabolic sensor.

5 - 10 bars inclusive
2 m



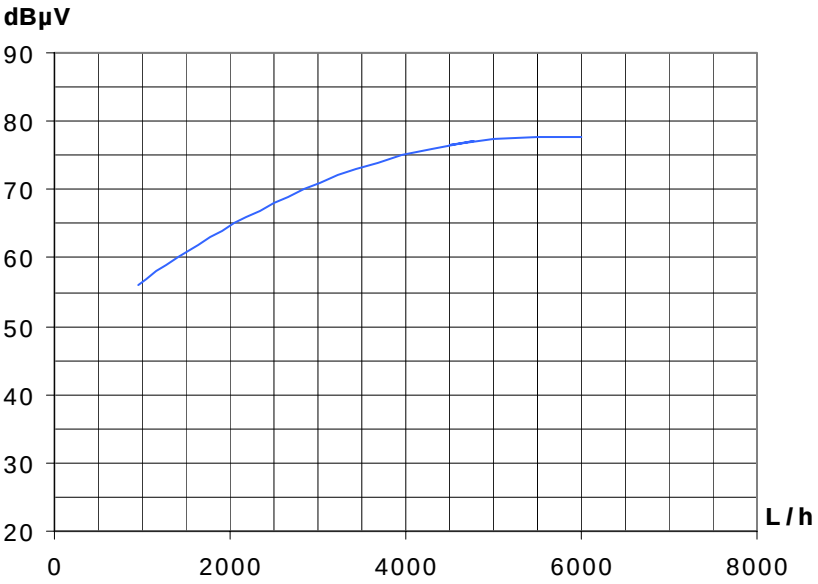
dBµV	L/h	SCCM	SCFM
65	756	12600	0.445
66	855	14250	0.503
67	956	15933	0.563
68	1059	17650	0.623
69	1165	19417	0.686
70	1274	21233	0.750
71	1385	23083	0.815
72	1500	25000	0.883
73	1618	26967	0.952
74	1740	29000	1.024
75	1866	31100	1.098
76	1996	33267	1.175
77	2132	35533	1.255
78	2274	37900	1.338
79	2422	40367	1.426
80	2580	43000	1.519
81	2744	45733	1.615
82	2920	48667	1.719
83	3110	51833	1.831
84	3318	55300	1.953
85	3548	59133	2.088
86	3810	63500	2.243
87	4125	68750	2.428
88	4550	75833	2.678

Quantifying a compressed air loss.

Measurements with the SDT 170 and the parabolic sensor.

5 - 10 bars inclusive

5 m



dBµV	L/h	SCCM	SCFM
56	944	15733	0.556
57	1052	17533	0.619
58	1164	19400	0.685
59	1280	21333	0.753
60	1400	23333	0.824
61	1516	25267	0.892
62	1632	27200	0.961
63	1770	29500	1.042
64	1902	31700	1.120
65	2040	34000	1.201
66	2186	36433	1.287
67	2333	38883	1.373
68	2490	41500	1466
69	2656	44267	1.563
70	2830	47167	1.666
71	3016	50267	1.775
72	3217	53617	1.894
73	3438	57300	2.024
74	3682	61367	2.167
75	3964	66067	2.333
76	4305	71750	2.534
77	4776	79600	2.811

Table correlating the diameter of the leak, its volume and the loss of energy.

Diameter of the leak		Volume of air lost at 6.2 bars			Power required
mm	inch	L/h	SCCM	SCFM	kW
1.6	1/16	3 570	59 466	2.1	0,3
3.2	1/8	36 040	600 320	21.2	3,1
6.4	1/4	97 240	1 619 732	57.2	8,3
9.5	3/8	378 250	6 300 533	222.5	33
Information source for this table: Atlas Copco Compressed Air.					

Annual cost in electricity for the compressor power supply.

Pk	kWh	Cost (EUR)	Cost (USD)
5	3.7	1 196	1 415
10	7.4	2 391	2 830
20	14.7	4 712	5 576
30	22.1	7 102	8 405
60	44.2	14 134	16 727
100	73.6	23 628	27 962
150	110.4	35 442	41 943
300	220.8	70 814	83 803
500	368.0	117 998	139 643
700	515.2	165 254	195 567
1000	736.0	236 068	279 370

Base 24h/24h=8,760 h/year *Price:€0.037/kWh*

8. Some practical advice.

1. Use simple screen effect techniques in order to eliminate any parasitic noise.

Ultrasounds are directional, in other words, they spread in one direction only. Use your body or a piece of cardboard to make a screen between the parasitic ultrasound (from the bleed valve for example) and the place where you are trying to detect the leak. Put a rag or your hand above the sensor in order to indicate the exact location of the leak.

2. Be careful of reflection phenomena.

When looking for a leak it seems sometimes that the leak is coming from a wall, a partition, the ground or a place where it is obvious that no ultrasound is being created. We are then faced with the laws of reflection. Ultrasounds are partially absorbed by the material on which they are reflected and partially reflected by this material. When faced with a reflection phenomenon, you must estimate the angle of reflection and place yourself in the direction of the angle of incidence (the direction the leak is coming from). In relation to the reflection surface the two angles are equal. When looking for the leak in the direction of incidence the height where it is detected in the headphones should be higher than the height detected in the direction of reflection.

3. Absorption of ultrasound.

As we have already described in the trick above, part of the ultrasound signal is absorbed by the object on which the ultrasounds are reflected. This absorption factor depends entirely on the material of the object on which the ultrasound signals are reflected. A fabric-covered surface absorbs the sound much more or reflects it much less than a concrete or metal surface.

4. Locating a leak precisely.

It isn't normally enough to stop detecting a leak a few centimetres away from the assumed leak. In order to locate the leak precisely you must always check the area surrounding it because the precise location of the leak may be in the same direction as the one you were looking for. All the more so if a compressed air system is behind a pipe or a flange. This is why it is advisable to carry out an inspection of the area all around the suspected leak.

5. Quantifying leaks.

To quantify leaks as accurately as possible you must always start from the maximum dBµV value.

This is equivalent to the highest leak sound detected.

Only the highest value can be considered, recorded in the internal memory and then transferred to the computer. By inserting these values in the appropriate Excel lists, it becomes easy to calculate the total air loss (loss in €).

Detecting leaks in compressed air systems is a double-edged issue: an environmental one for each one of us and an economic one for every business. Is it because it's an environmental issue that so few business managers feel worried about the topic? Then let's deal with this issue based on the substantial savings that can be made by eliminating this tremendous waste.

A proactive, ultrasonic leak detection campaign quantifying the amount of compressed air lost can be used to calculate the amount of savings made. The figures then speak for themselves and will convince you to implement a better energy efficiency management programme.

Eliminating compressed air leaks has immediate benefits both for the environment and for your finances. More generally, admittedly, measures aimed at protecting the environment will incur some costs. In this case, on the other hand, this is balanced out by the benefits. And what is more motivating than combining this with the future of generations to come!

The detection of leaks in compressed air systems, a measure that is within the grasp of any company, is an important step in its commitment to an active energy management policy.

The solution is there. It is simple and easy to implement. It enables you to make substantial savings and goes well beyond eliminating a great waste of energy.

And however, compressed air is still often forgotten when programmes for reducing production costs are drawn up.

André DEGRAEVE, Manager SDT International

SDT International s.a.
Bd. de l'Humanité 415,
B – 1190 Brussels (BELGIUM)
Tel: ++32.2.332.32.25
Fax: ++32.2.376.27.07
e-mail: info@sdt.be
web page: http://www.sdt.be